

the question be asked: has the rise in the sea level in the last 25 to 30 years been accentuated directly by a secular trend in phase with a longer climatic trend. Much emphasis has been placed on the geological reasons for the rise in the sea while the important meteorological aspects have not been completely investigated. These weather effects are so definitely related to the height of the sea for the day, week, month, and year that if they are not consistent over longer periods, a change in sea level, as sea level is computed, must occur. The fascinating explanation by Willett [7] [8] of climatic fluctuations, both long and short, may prove the key to the solution of most of the problems of variation in sea level. In any event, it would be interesting to observe the sea level in some future period if the wind, pressure, and rainfall were to return to the same values as occurred from 1926 to 1931.

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## Weather Notes

### TORNADOES OF BLACKWELL, OKLA.-UDALL, KANS., MAY 25, 1955

The climax of several days of tornadic and severe thunderstorm activity late in May 1955 occurred on the night of May 25. A tornado struck at Blackwell, Okla., killing 20 persons and injuring 250 with property damage in the millions.

About an hour later a tornado struck Udall, Kans., some 40 miles north-northeast of Blackwell. The tornado traveled in a general southwest to northeast direction across the center of town. Most of this south-central Kansas town of about 750 population was leveled. The death toll stands at 80 at this writing, and 250 were injured.

The purpose of this note is to present some personal observations reported to the authors by several eyewitnesses of these disasters.

**Braman, Okla.**—On the morning of May 25, Mr. H. M. Fox, a farmer who lives 6 miles west and 1 mile south of Braman, Okla. (see fig. 1 for locations), observed an unusual wind storm. His account follows: "The first that I noticed the storm was about 8:30 a. m., and the appearance was of a dense thunderstorm with possible hail. About 8:45 a. m. we had a very strong wind practically out of the south with a little variation to the east. I would estimate this wind at about 70 to 80 miles per hour. What struck me peculiar at the time was that there were no gusts. It was a straight and continuous wind for approximately 15 minutes. This strip of wind in width was probably 2 miles wide. It blew roofs off buildings, tore down steel buildings, TV towers and anything else that wasn't really fastened down. Immediately after the wind let up, we were out surveying the damage and we noticed that the wind would be light and variable and run from cool to hot. During the storm and immediately following, we had no hail and very little rain, probably 0.04 during the storm and afterward. Going on west from my farm, the next 2 or 3 miles had wind but no damage was noticeable. In the next 3 miles (a strip running north and south) there was also heavy damage. Then we had another strip of about 3 miles where there was no apparent damage. Right east of Caldwell, Kans., there was another strip of perhaps 2 or 3 miles that was heavily damaged. That afternoon beginning at 12 o'clock preceding the tornado at Blackwell that night, the skies were of broken clouds and the wind alternated from hot to cold for several hours."

**Tonkawa, Okla.**—Mrs. Robert C. Walker reported seeing the funnel of a tornado located about one mile east of Tonkawa. Mrs. Walker had a microbarograph in operation at the time. When the tornado was sighted east of town, the barogram showed a sharp fall of about 0.08 inch Hg followed by a sharp rise of about 0.10 inch Hg. (The minimum pressure was recorded at about 2055 csr, however there was no time check with which to determine the accuracy of the time element.) Shortly after 2100 csr the

"worst hail in the history of our city" fell but with only light winds. Hail was heavier to the west. Some of the hail that fell in town measured almost 3 inches in diameter.

**Blackwell, Okla.**—The tornado struck Blackwell, Okla., about 2127 csr. It traveled from south to north with almost complete destruction over a path about two blocks wide, and considerable destruction extended 3 or 4 blocks farther on either side. Mr. Nave, who lives just south of the south city limits of Blackwell, reported a short period of wind and hail (about 2 inches in diameter). Then followed a quiet during which he went outside. Instead of the air being cool following the squall, it was "hot." Then the tornado funnel was sighted approaching from the south. It came with "the roar of forty freight trains." There was lightning all around but not in the immediate vicinity of the funnel.

Mr. B. H. Jones living on the north side of Blackwell, about 4 blocks from the damaged area, reported squally weather with wind, rain, and hail followed by a short period of quiet. He went outside, heard the "roar," and immediately sought shelter. Upon emerging, he saw the tornado funnel leaving town in a north-northeasterly direction, still in contact with the ground.

The pattern of debris at Blackwell gave the appearance of more inflow than actual rotation in the sense that trees to the west of the center of the path had been blown eastward, and those to the east had been blown westward. Debris from the buildings yielded little information because of the difficulty in being able to determine from whence it came.

**Eight Miles West of Arkansas City, Kans.**—Following are two eyewitness accounts from an area about 23 miles north-northeast of Blackwell close to U. S. Highway 166, about 8 miles west of Arkansas City, Kans., Mr. and Mrs. Post, who live at a farm just south of the highway, report that their power failed at 9:58 p. m. (time ascertained from a stopped electric clock) followed in about 5 minutes by hail and shortly thereafter by a terrible roar. This was followed by a quiet lull which lasted probably less than a minute. The storm struck again, blowing down several large trees. These trees lying down toward the east must have been felled by a west wind. The couple was in the house the entire time, but looked out the windows during the course of the storm. When the initial roar was heard only blackness was visible to the south. After the tornado had passed over, it was clearly visible to the north against the background of almost constant lightning farther to the north. Neither Mr. nor Mrs. Post experienced any sensation of change of pressure during the course of the storm.

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The Earl Bennett farm is located about 2½ miles north-northeast of the Post farm. Mr. Bennett was roused from bed between 10:05 and 10:10 p. m. Wednesday by hail, some as large as hen's eggs, which fell covering his yard. This was accompanied by severe and constant lightning. Then the storm struck, destroying several outbuildings. This was followed by a lull which lasted half a minute. Strong winds again struck suddenly (direction of winds unknown) but apparently with no further damage. Looking out to the north, Mr. Bennett saw the tornado funnel which was back-lighted by constant lightning farther to the north. He described the funnel as hanging down from a black cloud and gyrating slowly back and forth. He estimated it to be about a quarter of a mile in diameter in its lower portions. From the pattern of destruction of the Bennett farm it was not possible to deduce the direction of winds causing the damage. Debris which was carried as far as a mile to the north-northeast was relatively light in weight and was probably carried in the vortex.

Both of these accounts seem to indicate that the tornado funnel was on the trailing edge (south-southwest) of the parent thunderstorm itself, the parent thunderstorm being identified by the hail and severe lightning. Both accounts identified a quiet lull lasting for a minute or less between two storm surges suggestive of an "eye." In one case destruction occurred after the lull and in the other case before the lull. Neither eyewitness reported any sensation of change in pressure, having been questioned on that specific point. Both accounts indicated the absence of heavy rain accompanying the parent thunderstorm or the tornado, referring to the rain as "light."

**Oxford, Kans.**—A tornado struck just north of Oxford, Kans., about 2220 cstr doing considerable damage, completely destroying several sets of farm buildings and killing five children from one family. Little information of meteorological significance is available from this area. One witness reported an automobile going "straight up" and being deposited eastward several hundred yards from its initial position.

**Udall, Kans.**—Udall, Kans., about 30 miles southeast of Wichita, underwent almost complete destruction from the tornado which struck about 2235 cstr. Motorists were reported to have seen the tornado funnel approaching Udall. It struck the southwest corner of the town first, traveling almost due northeast with destruction occurring over the entire width of the town, about three-fourths of a mile. The only habitable structure left in town was a frame dwelling with only minor damage on the extreme northwest edge of town. Except for a few other dwellings in the northwest corner of town which were twisted, moved, and badly damaged, the only buildings in town not completely leveled were a few two-story masonry buildings from which the upper story had been removed. There was evidence of rotation although it was confused somewhat by the pattern of light-weight debris, much of which indicated a southwest to northeast flow. It was not uncommon, for instance, to see a large tree having fallen to the southwest, and a large piece of tin wrapped around a smaller nearby tree with its free edges pointing northeastward, obviously having been carried by a southwest wind. Destruction requiring immense forces however did yield indications of cyclonic rotation. A municipal water tower in the northwest part of town was toppled toward the southwest. The center of rotation passed across and at almost right angles to a train of railroad cars on a railroad siding. The cars to the northwest of the center were blown off the tracks to the southwest and the cars to the southeast of the center were blown to the northeast, although some cars between (over a distance of about 1½ city blocks) were still on the tracks.

Some evidence was found of "explosive" effects. A concrete block building about 30 feet by 40 feet stood in the southwest part of town and was apparently near the path of the center of the tornado. All four walls had fallen outward, leaving the floor area relatively clear of debris.

Eyewitness accounts were not available from Udall until several days afterward because of understandable confusion and the shock that most survivors suffered. Wheeler Martin, a survivor from Udall, reported that there was a "roaring noise" at about 2220 cstr followed by hail and rain. The wind was from the southwest and getting stronger. After a few minutes, the house began to shake. At 2235 cstr it "collapsed." The hail continued for several minutes.

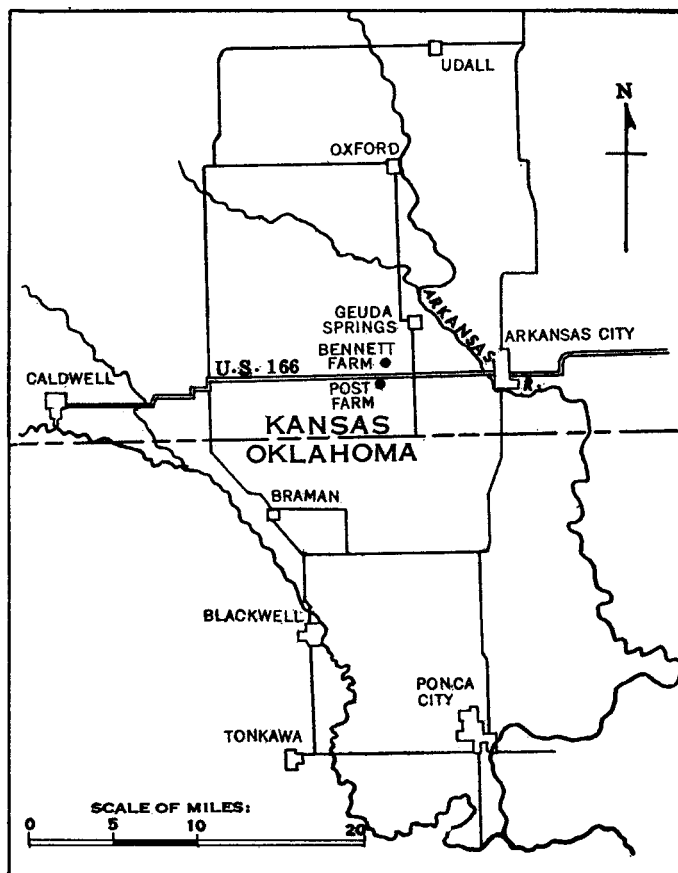


FIGURE 1.—General location map for Blackwell, Okla.-Udall, Kans., tornadoes, May 25, 1955.

Beyond Udall, the path of major destruction ended. Spotty damage extended for 18 miles east-northeast of Udall.

A carefully conducted survey of damage accomplished by one of the authors Mr. Phillips revealed almost positive indications that at least from the time the tornado crossed U. S. Highway 166 and throughout its northward traverse through Udall, a continuous path of destruction was apparent. There was some "skipping" but the greatest skip was on the order of 3½ miles.—Victor V. Phillips, MIC, WBAS, Wichita, Kans.; Joseph G. Galway, SELS Center, Kansas City, Mo.; and Donald M. Hanson, District Forecast Center, Kansas City, Mo.